AFWAL-TR-83-4128

ADA 139092

REVISION OF DESIGN VALUES FOR 7075-T7351 AND 7075-T7651 ALUMINUM PLATE

Lt. J. D. Tirpak
Materials Integrity Branch
Systems Support Division

January 1984

Final Report for Period August 1982 - May 1983

Approved for public release; distribution unlimited

MATERIALS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

Jon D. Tirpak

JON D. TIRPAK, 2Lt, USAF
Engineering & Design Data
Materials Engineering Branch

Clayton L. Harmsworth

CLAYTON L. HARMSWORTH
Technical Manager
Engineering & Design Data
Materials Engineering Branch

FOR THE COMMANDER:

THEODORE J. REINHART, Chief
Materials Engineering Branch
Materials Laboratory

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER AFWAL-TR-83-4128	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) REVISION OF DESIGN VALUES FOR 7075-T7351 AND 7075-T7651 ALUMINUM PLATE		5. TYPE OF REPORT & PERIOD COVERED Final Report August 1982 - May 1983
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Lt. J. D. Tirpak		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Materials Laboratory (AFWAL/MLSE) Air Force Wright Aeronautical Laboratories (AFSC) Wright-Patterson AFB, OH 45433		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Project 2418 Task 241807 Work Unit 24180703
11. CONTROLLING OFFICE NAME AND ADDRESS Materials Laboratory (AFWAL/ML) Air Force Wright Aeronautical Laboratories (AFSC) Wright-Patterson AFB, OH 45433		12. REPORT DATE January 1984
		13. NUMBER OF PAGES 28
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

7075-T7351
7075-T7651
Mechanical Properties
Plate Thickness Effects

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

7075-T7351 and 7075-T7651 aluminum plates of varying thicknesses were mechanically tested to verify certain design allowables used in the initial B-1 design. For the 7075-T7351 alloy,tensile and compressive strengths decreased slightly with increasing plate thickness. 7075-T7351 shear strengths increased very slightly with increased plate thickness. Bearing strengths varied noticeably with plate thickness, therefore requiring two data sets to characterize design allowables. This variation was at least partially due to different specimen location. For the 7075-T7651 alloy, more test plates of varying thicknesses are

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) needed for a complete statistical analysis.

PREFACE

This report was prepared by the Materials Integrity Branch (AFWAL/MLSE), Systems Support Division, Materials Laboratory, Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, Ohio, under Project 2418, "Aerospace Structural Materials," Task 241807, "Systems Support," Work Unit 24180703, "Engineering & Design Data."

The work reported herein was performed during the period August 1982 - May 1983, the mechanical property testing was performed by Capt Scott Jarvis and the final report was authored by 2Lt Jon D. Tirpak (AFWAL/MLSE). The report was released by the author in October 1983.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION I

BACKGROUND

During the early 1970's, the initial B-1 bomber design specified the use of 7075-T7351 and 7075-T7651 aluminum plate in certain damage tolerant critical locations. Since that time however, the Aluminum Association has agreed that they would guarantee fracture toughness only for a new generation of alloys specially processed for improved fracture properties. In the case of the B-1, the appropriate replacement for 7075 plate would be 7475 plate and it has so been selected for production.

In reviewing all the design properties for these respective alloys, it was noted that shear and bearing properties reported in MIL-HDBK-5 for 7475-T7351 and 7475-T7651 were lower than values reported for 7075 with respective tempers. The 7075-T7351 and -T7651 property data were generated in the late 1960's under less stringent statistical requirements than those now in effect. The 7475-T7351 and -T7651 allowables were approved in the late 1970's and were analyzed under the new guidelines requiring a larger number of different lots of material.

In order to assist the B-1 SPO and at the same time statistically reanalyze 7075-T7351 and -T7651 for MIL-HDBK-5, the Systems Support Division (MLS) conducted test programs to obtain supplemental data. Plate material for the program was supplied by Lockheed, General Dynamics, Sikorsky, Alcoa and McDonnell Douglas in thicknesses ranging from 0.375 to 3 inches. Tensile, compressive, shear and bearing tests were performed by the Systems Support Division (MLS). The data generated by this program and published in this report has been submitted to Battelle, Columbus, Ohio for additional analysis and eventual incorporation into MIL-HDBK-5.

SECTION II

TEST PROGRAM AND PROCEDURES

1. MATERIAL

7075-T7351 and 7075-T7651 plates of varying thickness were supplied to Systems Support Division (AFWAL/MLS) by several companies. Table 1 lists these suppliers and thicknesses.

2. SPECIMEN

Figure 1 shows the test specimen orientation with respect to the rolling direction of the plate. Test specimens were machined from the plates as shown in Figures 2 - 5. All specimens excised from plates 1-1/2 inches thick or less were taken from the center thickness location while all specimens from plates greater than 1-1/2 inches were taken from the 1/4 thickness location. These locations are specified by ASTM Standard B557 and AMS Standard 2355.

3. TEST PROCEDURES

Tensile tests were performed in a 20,000 lb. capacity Instron tensile testing machine. A 1/2-inch Instron extensometer was used on the short tensile specimens while a 1-inch Instron extensometer was used on the round tensile specimens to obtain strain measurements. ASTM Standard E8, "Tension Testing of Metallic Materials," was followed.

Compression tests were governed by ASTM Standard E9, "Compression Testing of Metallic Materials at Room Temperature." Dual strain gaged specimens were tested on a Satec compression sub-press mounted in a 20,000 lb. Instron machine.

The 20,000 lb. Instron was also used to conduct shear tests. No ASTM standards for shear testing exists. Specimens were sheared using a double shear tool.

Bearing tests were performed in accordance with ASTM Standard E238, "Pin-Type Bearing Test of Metallic Materials." Two edge to distance ratios were tested; e/D = 1.5 and e/D = 2.0. Again, testing was performed using the 20,000 lb. Instron machine.

In all cases, tests were conducted in laboratory air at room temperature and 20 - 30 percent relative humidity.

SECTION III

RESULTS AND DISCUSSION

The tensile, compressive, shear and bearing test data for 7075-T7351 and 7075-T7651 are presented in Tables 2 and 3. Figures 6 - 10 graphically depict the 7075-T7351 data to show the effects of plate thickness on mechanical properties.

For 7075-T7351 tensile and compressive properties decreased slightly as plate thicknesses increased from .375 inches to 3.0 inches. Figures 6 through 8 illustrate this effect. Figure 6 shows that ultimate and yield strengths and percent elongation in the L-T direction decreased slightly as plate thicknesses increased. 7075-T7351 in the S- T direction behaved similarly as shown in Figure 7. A comparison of L-T and S-T ultimate and yield strengths as affected by plate thicknesses 1.5 inches and greater was made in Figure 8. Ultimate and yield strengths for the T7351 condition were slightly greater in the L-T direction than in the S-T direction. In both cases though, tensile strengths decreased with increased plate thickness.

Shear and bearing properties behaved differently than tensile and compressive properties as plate thickness increased. Shear and bearing test data were plotted as shown in Figures 9 and 10. From .325 to 1.50 inches of plate thickness, both shear and bearing strengths decreased between 1.5 and 1.75 inches of plate thickness, shear and bearing strengths increased noticeably to a maximum. As plate thickness increased from 1.75 inches, shear and bearing strengths again decreased. The inflections at 1.5 and 1.75 inches of these plots suggests that the specimen location determines the properties of the material. For thicknesses up to 1.5 inches, specimens are located at half of the plate thickness. For thicknesses greater than 1.5 inches, specimens are located at one quarter of the plate thickness. By using two different specimen locations, thickness/2 and thickness/4, as specified by test standards, two different data sets result.

The shear test data varied by a greater amount from the original MIL-HDBK-5 data than any other data. It appears that the variation was due to the test fixture design which is a conventional double-shear tool. The double-shear tool lacks rigidity and provides less support to the shear specimen. These two factors are believed to account for the lower shear values obtained. In order to correct for these inadequacies a heavier shear tool, such as the Amsler shear tool, should be incorporated in a test standard.

7075-T7651 plates in 1.75 and 2.25-inch thicknesses were also tested. The L-T ultimate and yield tensile strengths were greater than the S-T ultimate and yield tensile strengths. Also the tensile compressive and shear strengths of the 1.75-inch plate were slightly greater than the strengths of the thicker 2.25-inch plate. This was also true of the bearing tests performed in the L and L-T orientations. Since only two plate thicknesses were sampled and there were limited data, plots were not constructed for 7075-T7651.

SECTION IV

CONCLUSIONS

7075-T7351 and 7075-T7651 tensile compressive, shear and bearing properties are affected by plate thickness.

Tensile and compressive strengths decrease with increasing plate thickness for both the T7351 and T7651 conditions.

7075-T7351 shear and bearing strengths are affected by plate thickness and specimen location within the plate. As plate thickness increases, shear and bearing strengths decrease. To compensate for the varying bearing strengths, two data sets should be used for analysis. One data set should be used for plate thicknesses up to 1.5 inches (T/2) and the second data set should be used for plates greater than 1.5 inches thick (T/4).

A shear test jig and test procedure should be standardized, since variations in testing can yield a variety of results.

Although 7075-T7651 appears to behave like 7075-T7351, more plate thicknesses must be tested.

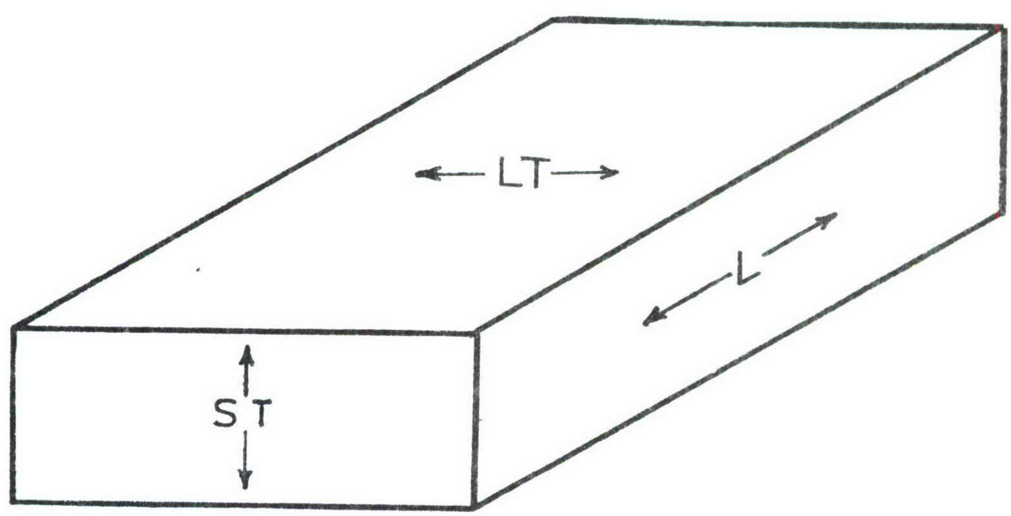


Figure 1. Specimen Orientation Diagram. L is the Rolling Direction.

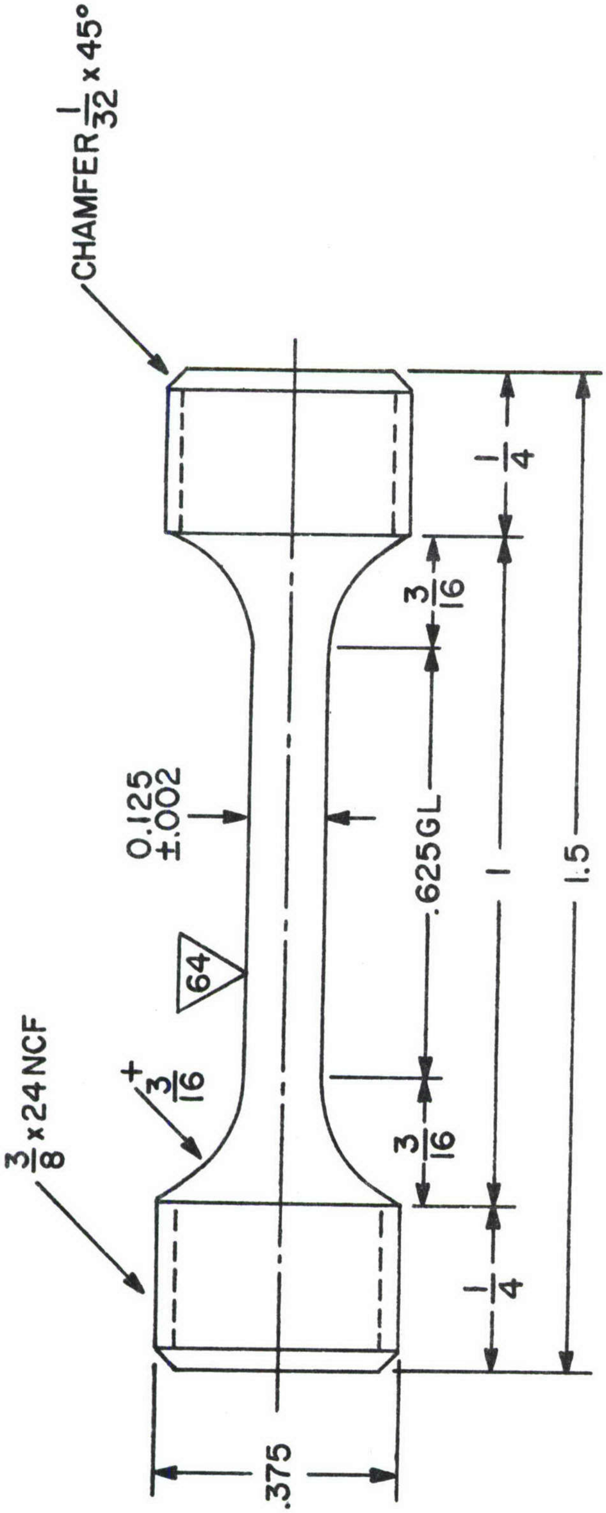


Figure 2. Short Tensile Specimen (in).

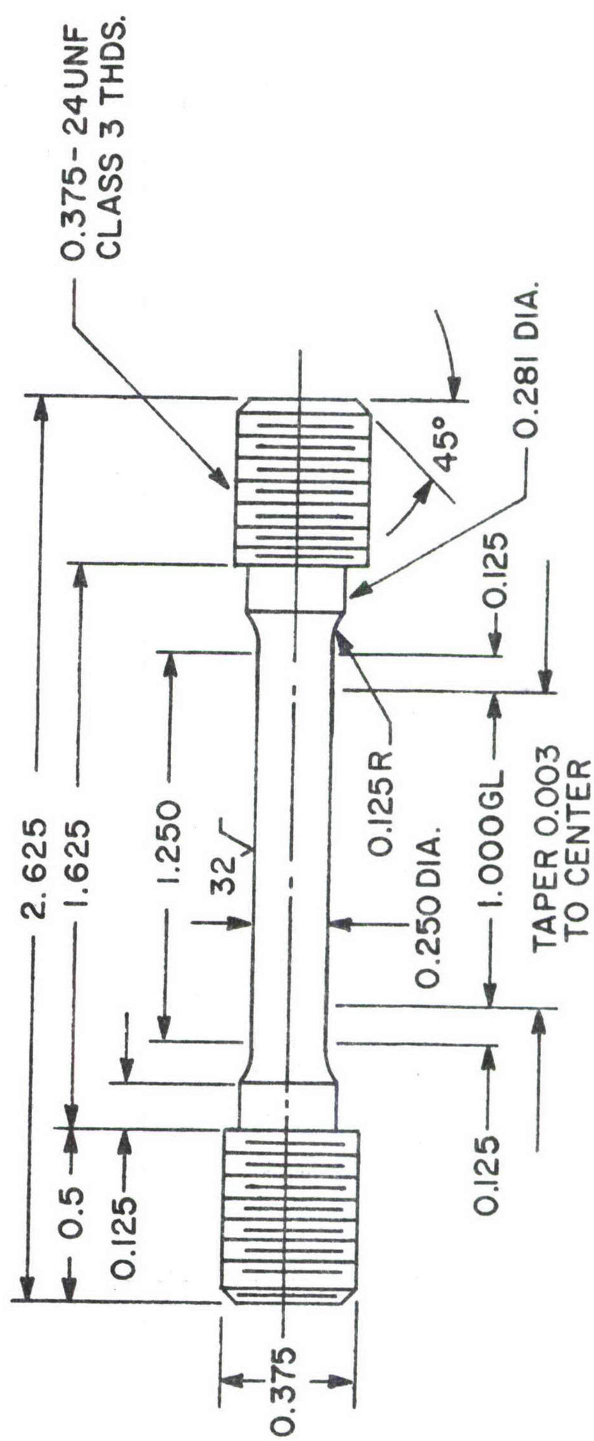


Figure 3. Round Tensile Specimen (in).

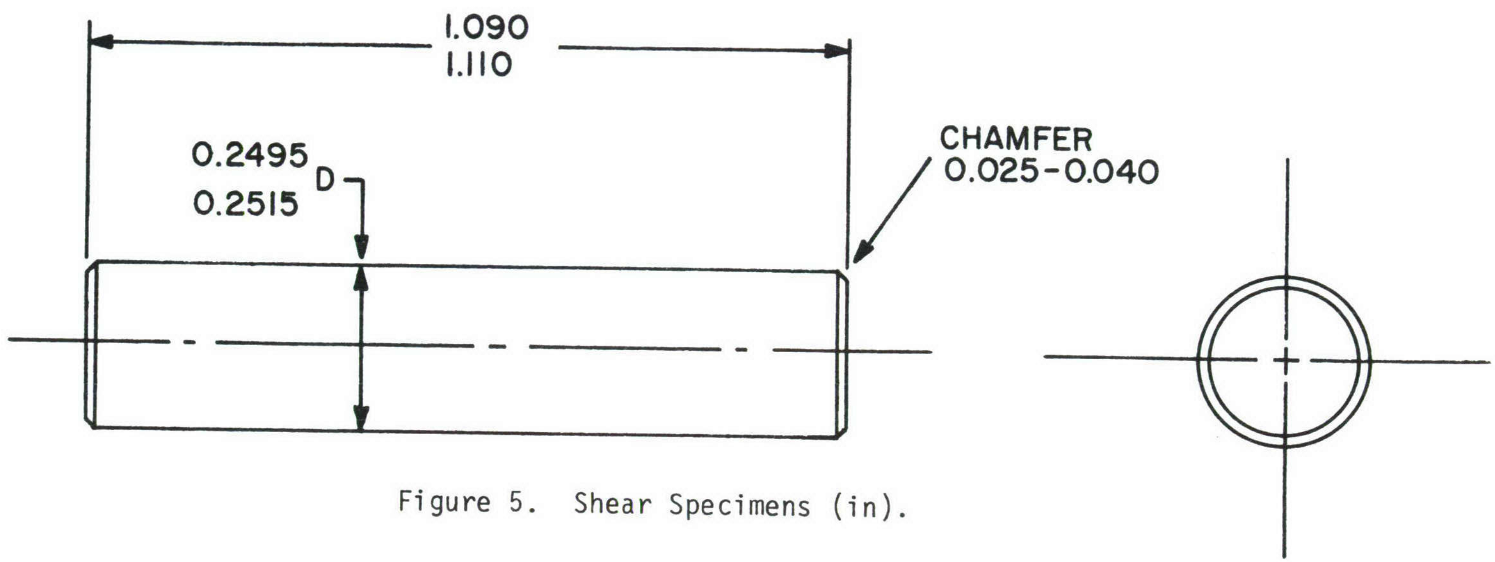
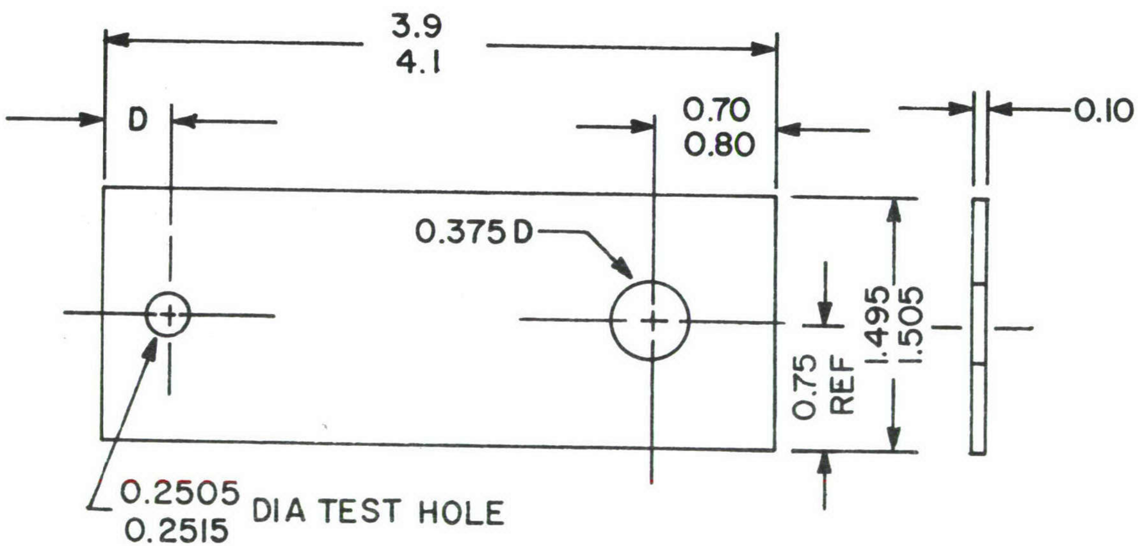


Figure 5. Shear Specimens (in).



SIZE	D
$1\frac{1}{2}$	0.375
2	0.500

Figure 4. Bearing Specimen (in).

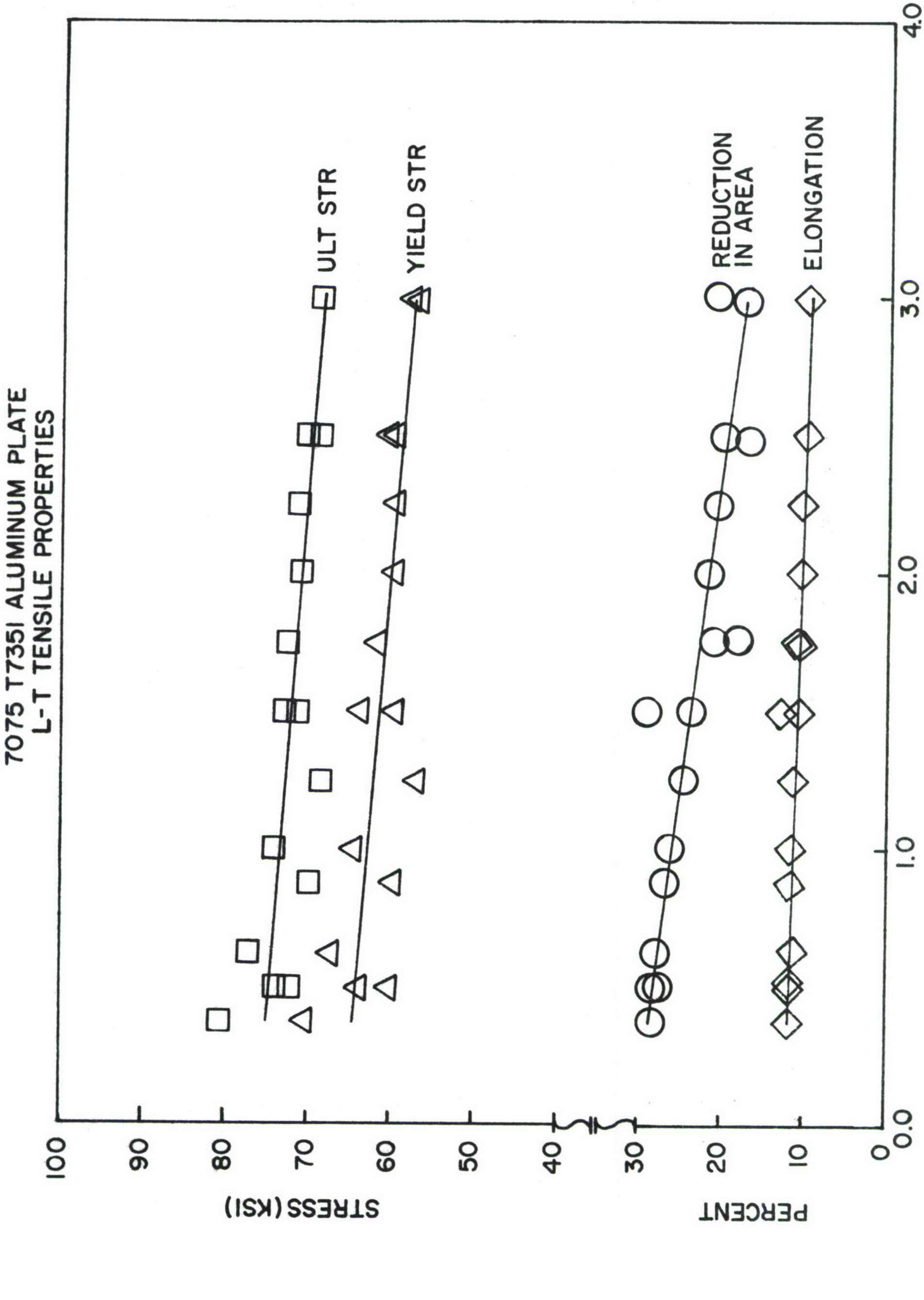


Figure 6. L-T Tensile Properties as Affected by Plate Thickness.

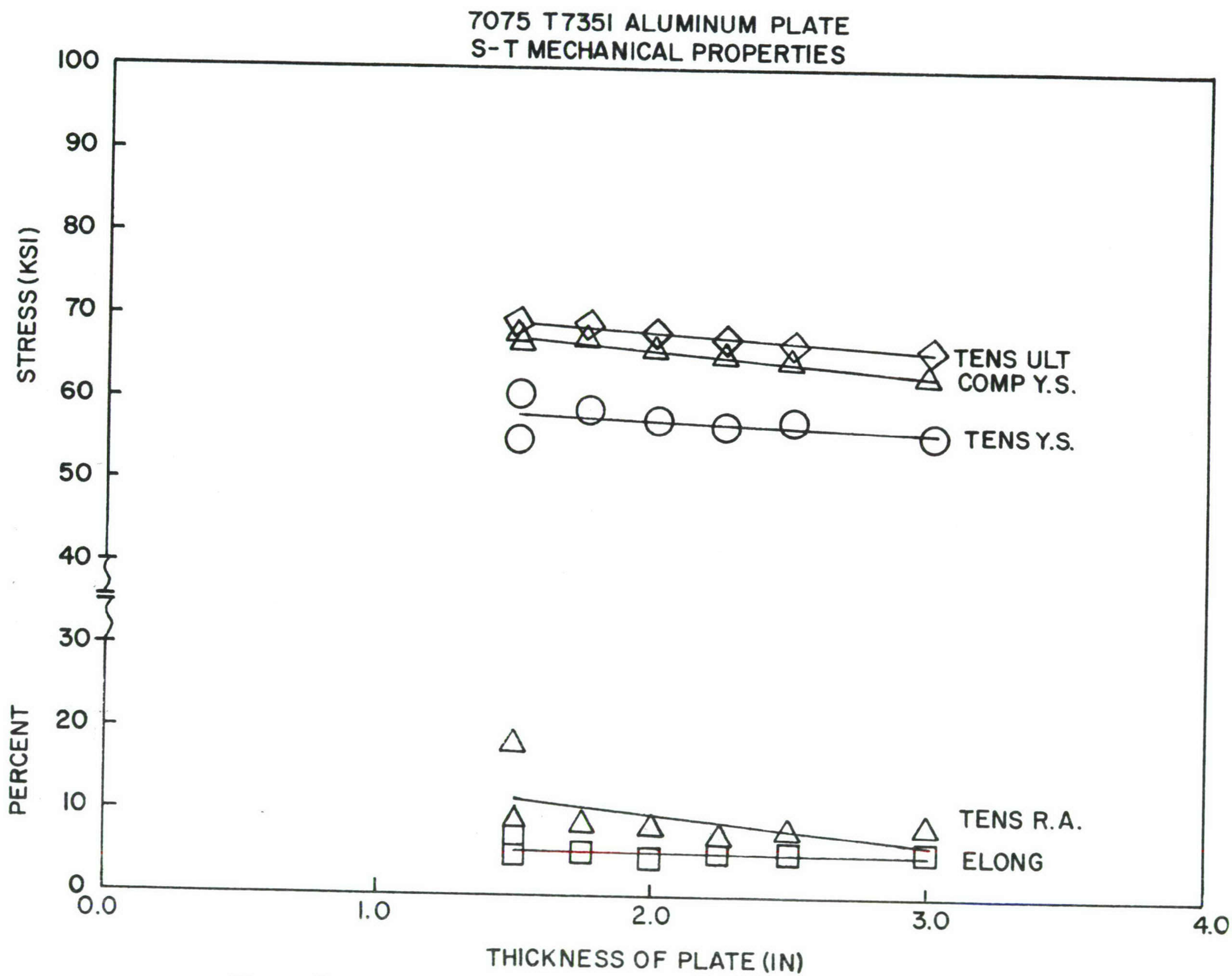


Figure 7. S-T Tensile and Compressive Properties as Affected by Plate Thickness.

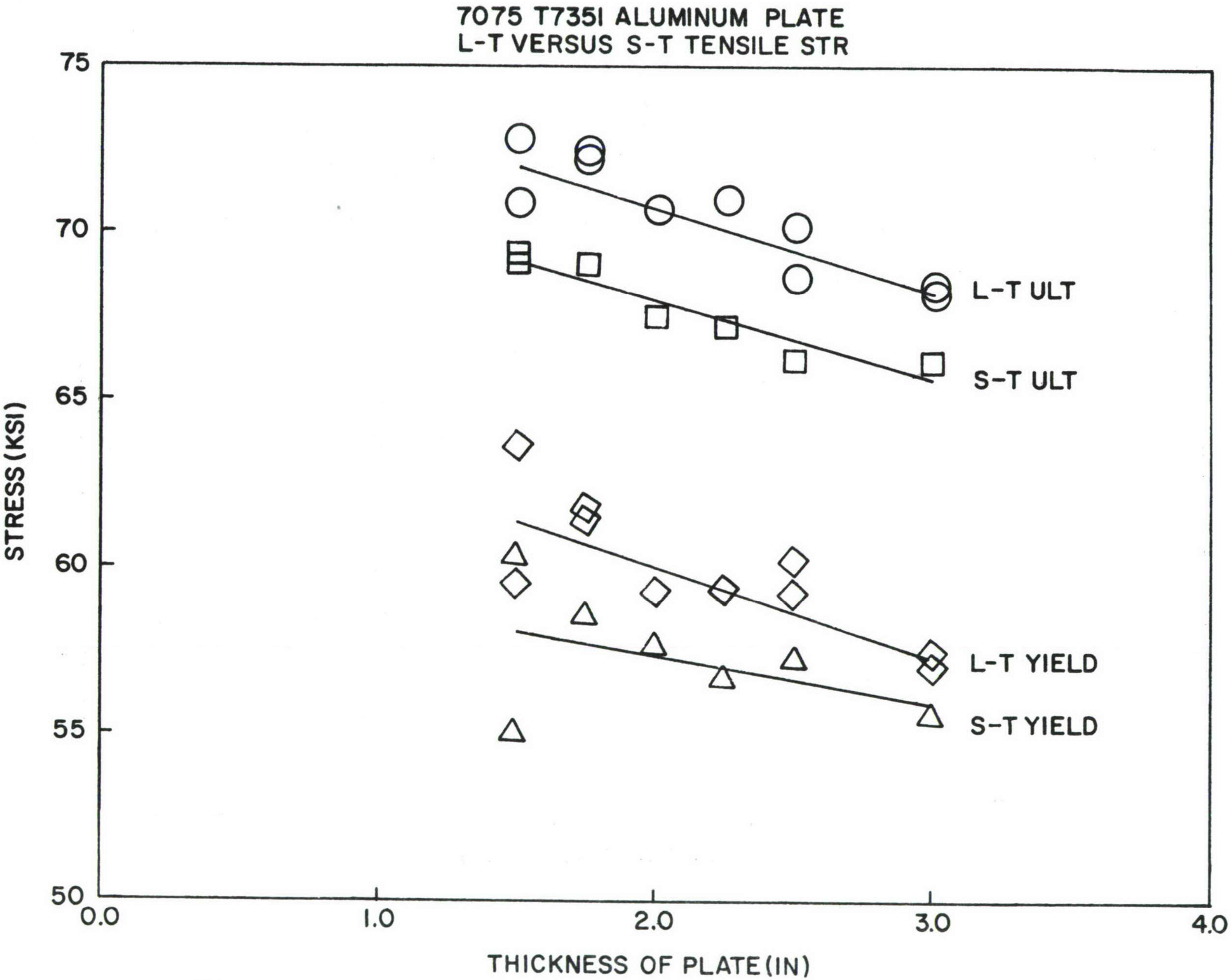


Figure 8. Comparison of L-T and S-T Tensile Strengths as Affected by Plate Thickness.

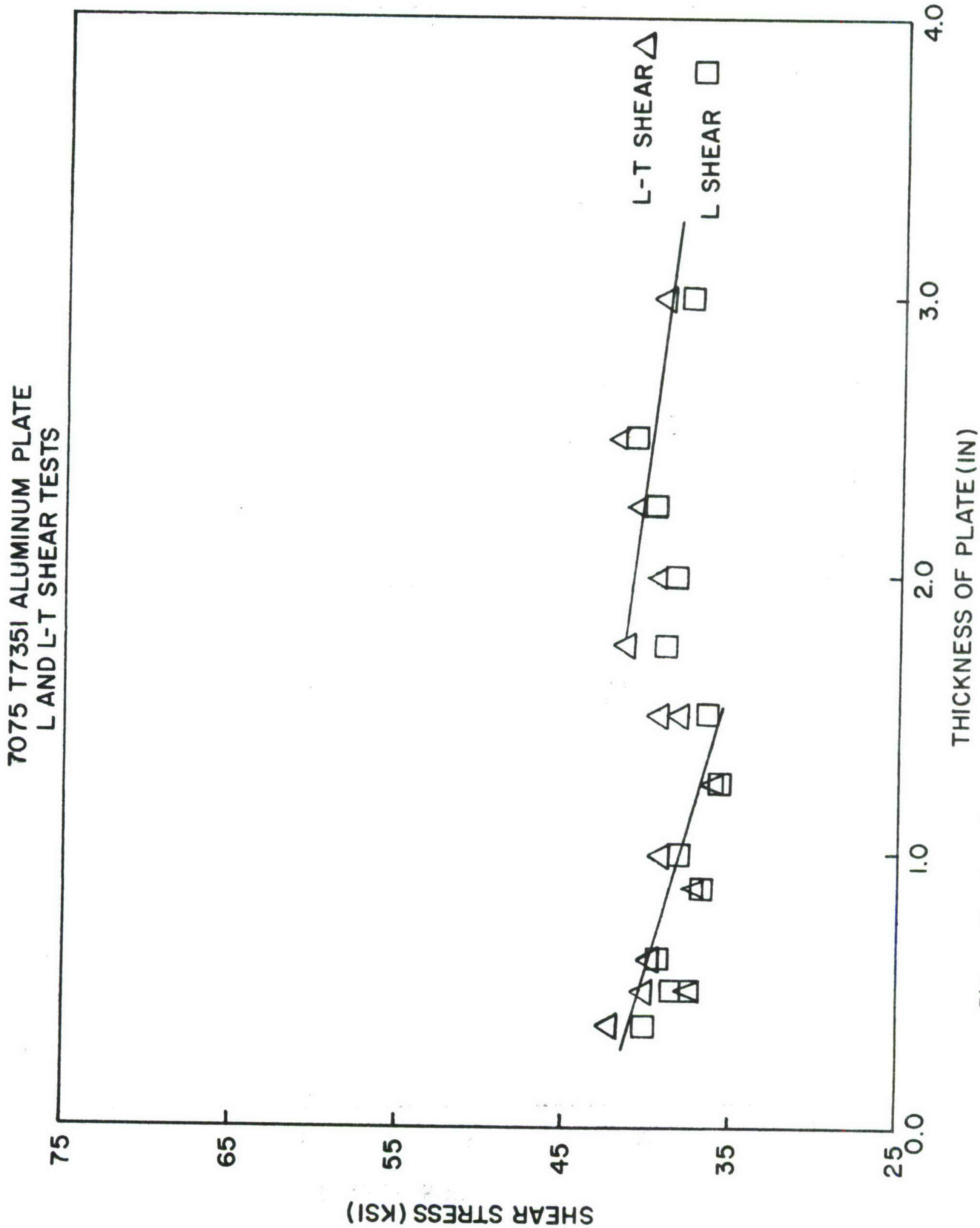


Figure 9. L and L-T Shear Strengths as Affected by Plate Thickness.

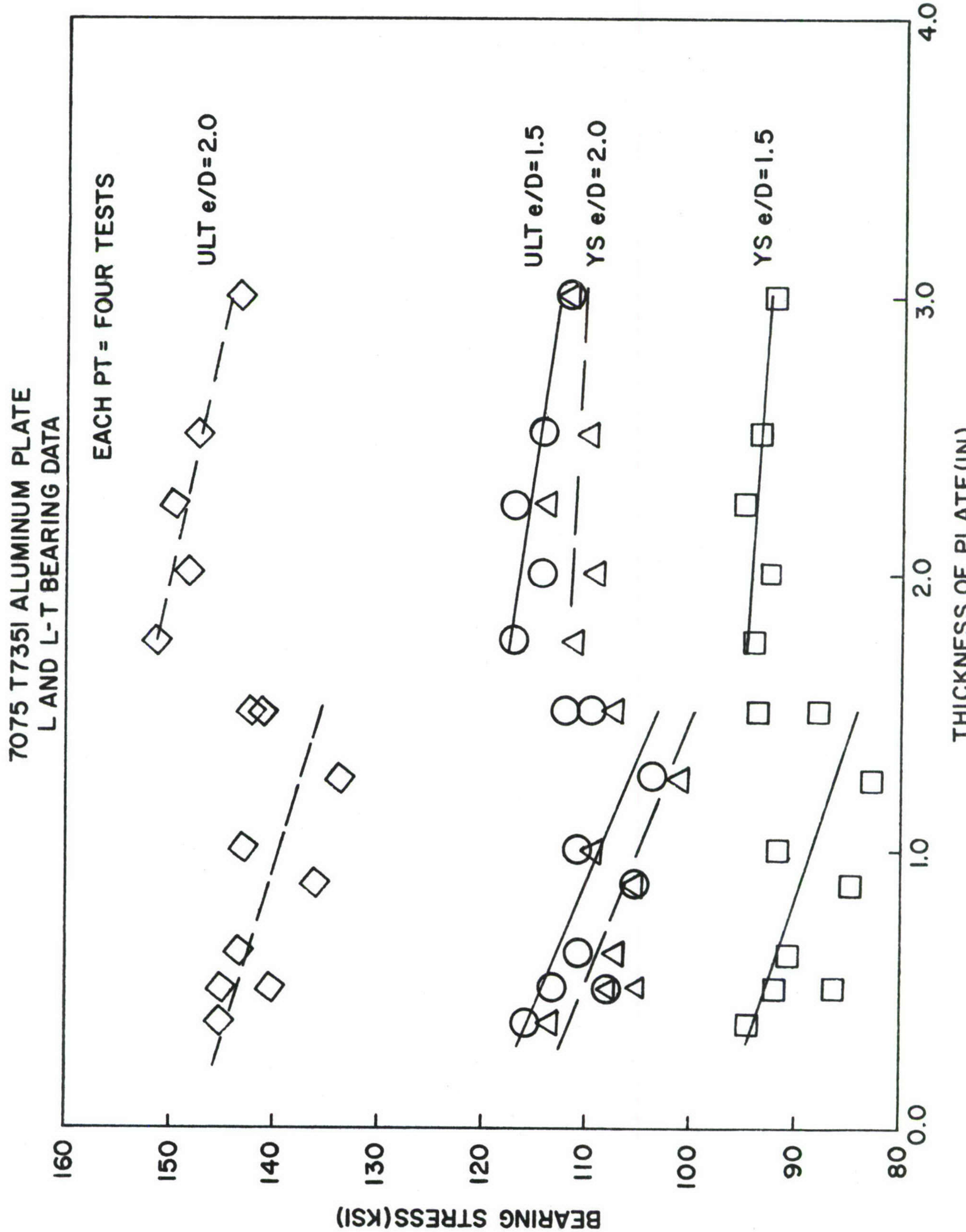


Figure 10. Combined L and L-T Bearing Data as Affected by Plate Thickness. (Data was Combined Since L and L-T Values Varied Little).

TABLE 1

7075-T7351 AND -T7651 TEST PROGRAM

Plate Thickness (in)	Heat Treatment	Supplier	Tests
.375	T7351	Lockheed-Georgia	4B-L, 4B-LT, 2ST-LT, 2S-L, 2S-LT
.500	T7351	Lockheed-Georgia	4B-L, 4B-LT, 2ST-LT, 2S-L, 2S-LT
.500	T7351*	Lockheed-California	B-L, 4B-LT, 2ST-LT, 2S-L, 2S-LT
.625	T7351	Lockheed-Georgia	4B-L, 4B-LT, 2RT-LT, 2S-L, 2S-LT
.875	T7351	Lockheed-Georgia	4B-L, 4B-LT, 2RT-LT, 2S-L, 2S-LT
1.000	T7351	Lockheed-Georgia	4B-L, 4B-LT, 2RT-LT, 2S-L, 2S-LT
1.250	T7351*	General Dynamics	4B-L, 4B-LT, 2RT-LT, 2S-L, 2S-LT, 2C-ST
1.500	T7351	Lockheed-Georgia	4B-L, 4B-LT, 2RT-LT, 2RT-ST
1.500	T7351*	Sikorsky	4B-L, 4B-LT, 2RT-LT, 2RT-ST
1.750	T7351*	Sikorsky	4B-L, 4B-LT, 2RT-LT, 2RT-ST
1.750	T7651	McDonnell-Douglas	4B-L, 4B-LT, 2RT-LT
2.000	T7351	Alcoa	4B-L, 4B-LT, 2RT-LT, 2RT-ST
2.250	T7351	Alcoa	4B-L, 4B-LT, 2RT-LT, 2RT-ST
2.250	T7651	Lockheed-California	4B-L, 4B-LT, 2RT-LT
2.500	T7351	McDonnell-Douglas	4B-L, 4B-LT, 2RT-LT, 2RT-ST
3.000	T7351	Alcoa	4B-L, 4B-LT, 2RT-LT 2RT-ST

*Reheat treated from T7651 condition to designated heat treatment.

B-L = Bearing in Longitudinal.
B-LT = Bearing in Long Transverse.
ST-LT = Short Tensile in Long Transverse.
S-L = Shear in Longitudinal.
S-LT = Shear in Long Transverse.
RT-LT = Round Tensile in Long Transverse.
C-ST = Compression in Short Transverse.

TABLE 2

MECHANICAL PROPERTIES OF 7075-T7351 PLATE

Nominal Thickness (in)	Specimen Location	Grain Direction	Tensile			Compressive	Shear	Bearing			
								e/D = 1.5		e/D = 2.0	
			Ultimate (ksi)	Yield (ksi)	Elongation %	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)
0.375	T/2	L					41.9	93.7	115.8	117.5	152.0
		L					42.4	92.3	117.3	108.8	130.4
		Avg.					42.1	93.0	116.5	113.1	141.2
		LT	80.5	70.1	11.8		39.9	94.9	114.7	112.2	148.8
		LT	80.3	69.9	11.9		40.1	97.3	116.1	114.3	149.8
		Avg.	80.4	70.0	11.8		40.1	96.1	115.4	113.2	149.1
0.500	T/2	L					40.1	92.7	111.0	106.0	144.2
		L					40.1	90.0	110.7	110.8	147.4
		Avg.					40.1	91.3	110.8	108.4	145.8
		LT	73.5	63.4	11.8		38.7	94.3	115.5	109.7	144.4
		LT	73.8	63.8	12.1		38.5	90.7	115.4	108.3	143.8
		Avg.	73.6	63.6	11.9		38.6	92.5	115.4	109.0	144.1
0.500	T/2	L					36.7	87.8	107.3	106.8	139.3
		L					38.2	86.0	107.3	105.6	139.9
		Avg.					37.4	86.9	107.3	106.2	139.6
		LT	71.4	59.7	11.4		37.0	86.1	108.5	108.3	141.0
		LT	71.9	60.3	11.7		37.8	85.4	108.6	99.9	140.3
		Avg.	71.6	60.0	11.5		37.4	85.7	108.5	104.1	140.6

TABLE 2

MECHANICAL PROPERTIES OF 7075-T7351 PLATE (Continued)

Nominal Thickness (in)	Specimen Location	Grain Direction	Tensile			Compressive	Shear	Bearing			
								e/D = 1.5		e/D = 2.0	
			Ultimate (ksi)	Yield (ksi)	Elongation %	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)
0.625	T/2	L					40.0	91.8	110.3	107.9	142.3
		L					39.3	88.9	110.2	103.3	142.0
		Avg.					39.6	90.8	110.2	105.6	142.1
		LT	77.1	67.0	11.3		39.0	91.8	111.2	107.2	143.5
		LT	76.9	66.8	11.3		39.6	89.9	111.2	109.9	143.8
		Avg.	77.0	66.9	11.3		39.3	90.8	111.2	108.5	143.6
0.875	T/2	L					37.3	87.1	105.6	103.9	135.0
		L					37.0	83.8	106.3	103.9	134.7
		Avg.					37.1	85.4	105.9	103.9	134.8
		LT	69.8	59.7	11.8		37.0	85.8	105.2	104.7	136.1
		LT	69.2	59.2	11.8		36.2	82.3	105.4	108.5	138.4
		Avg.	69.5	59.4	11.8		36.6	84.0	105.3	106.6	137.2
1.000	T/2	L					38.7	93.6	111.0	107.1	142.0
		L					39.6	90.5	110.4	103.9	143.7
		Avg.					39.1	92.0	110.7	105.5	142.8
		LT	73.8	64.2	11.6		38.2	91.8	110.9	112.9	142.4
		LT	73.8	64.2	11.9		37.7	90.9	110.9	112.6	143.4
		Avg.	73.8	64.2	11.7		37.9	91.3	110.9	112.7	142.9

TABLE 2

MECHANICAL PROPERTIES OF 7075-T7351 PLATE (Continued)

Nominal Thickness (in)	Specimen Location	Grain Direction	Tensile			Compressive	Shear	Bearing			
								e/D = 1.5		e/D = 2.0	
			Ultimate (ksi)	Yield (ksi)	Elongation %	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)
1.250*	T/2	L					36.1	81.6	101.9	100.4	133.8
		L					36.0	81.5	102.0	102.4	134.9
		Avg.					36.0	81.5	101.9	101.4	134.3
		LT	67.8	56.2	11.2		35.6	82.5	104.6	101.7	133.0
		LT	68.6	57.1	11.1		35.8	82.5	105.3	100.4	132.9
		Avg.	68.2*	56.6*	11.1		37.5	83.8	104.9	101.0	132.9
1.500	T/2	L					38.6	97.8	110.9	114.9	141.4
		L					39.9	94.4	112.2	107.3	142.0
		Avg.					39.2	96.1	111.5	111.1	141.7
		LT	72.8	63.6	10.6		38.3	92.6	111.4	110.6	142.5
		LT	72.8	63.5	10.1		34.7	89.9	111.9	105.0	142.5
		Avg.	72.8	63.5	10.4		36.5	91.2	111.6	107.8	142.5
		ST	69.5	60.1	4.5	67.4					
		ST	69.3	60.4	4.8	68.2					
		Avg.	69.4	60.2	4.6	67.8					

* Below QQ-A-250/12 minimum values

TABLE 2

MECHANICAL PROPERTIES OF 7075-T7351 PLATE (Continued)

Nominal Thickness (in)	Specimen Location	Grain Direction	Tensile			Compressive	Shear	Bearing			
								e/D = 1.5		e/D = 2.0	
			Ultimate (ksi)	Yield (ksi)	Elongation %	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)
1.500*	T/2	L					38.3	88.8	109.4	103.8	140.9
		L					37.8	86.9	109.2	107.2	141.9
		Avg.					38.0	87.8	109.3	105.5	141.4
		LT	71.0	59.5	12.6		36.3	87.9	109.9	107.5	141.5
		LT	70.8	59.4	12.9		36.2	87.5	109.9	109.6	140.7
		Avg.	70.9	59.4	12.7		36.1	87.7	109.9	108.5	141.1
		ST	69.5	56.4	7.2	65.7					
		ST	68.7	53.6	6.6	67.0					
		Avg.	69.1	55.0	6.9	66.3					
1.750*	T/4	L					41.3	96.0	117.5	112.8	151.8
	T/4	L					41.0	95.0	116.5	105.2	151.1
	T/4	Avg.					41.1	95.5	117.0	109.0	151.3
	T/4	LT	72.4	61.3	10.1		38.7	93.6	116.7	113.2	151.4
	T/4	LT	72.4	61.6	10.4		39.3	91.7	117.3	115.0	151.0
	T/4	Avg.	72.4	61.4	10.2		39.0	92.6	117.0	114.1	151.2
	T/2	ST	--	--	--	68.2					
	T/2	ST	69.0	58.5	4.9	65.7					
	T/2	Avg.	69.0	58.5	4.9	66.9					

TABLE 2

MECHANICAL PROPERTIES OF 7075-T7351 PLATE (Continued)

Nominal Thickness (in)	Specimen Location	Grain Direction	Tensile			Compressive	Shear	Bearing			
								e/D = 1.5		e/D = 2.0	
			Ultimate (ksi)	Yield (ksi)	Elongation %	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)
2.000	T/4	L					38.1	88.8	115.5	102.4	148.8
	T/4	L					40.7	98.2	112.8	102.5	147.0
	T/4	Avg.					39.4	93.5	114.1	102.4	147.9
	T/4	LT	70.7	59.4	10.1		37.0	91.9	115.1	114.7	148.4
	T/4	LT	70.7	59.1	10.5		39.6	91.9	114.2	116.8	148.4
	T/4	Avg.	70.7	59.2	10.3		38.3	91.9	114.6	115.7	148.4
	T/2	ST	68.9	58.6	4.7	65.7					
	T/2	ST	66.1	56.5	3.9	66.1					
	T/2	Avg.	67.5	57.5	4.3	65.9					
2.250	T/4	L					40.6	95.8	116.4	119.6	150.8
	T/4	L					40.7	97.0	117.8	107.5	149.9
	T/4	Avg.					40.6	96.4	117.1	113.5	150.3
	T/4	LT	70.7	59.0	10.3		39.5	91.7	115.3	113.3	148.3
	T/4	LT	71.2	59.5	10.5		39.7	95.6	116.1	114.9	149.0
	T/4	Avg.	70.9	59.2	10.4		39.6	93.6	115.7	114.1	148.6
	T/2	ST	67.4	56.7	4.9	64.6					
	T/2	ST	67.0	56.4	4.9	65.1					
	T/2	Avg.	67.2	56.5	4.9	64.8					

TABLE 2

MECHANICAL PROPERTIES OF 7075-T7351 PLATE (Continued)

Nominal Thickness (in)	Specimen Location	Grain Direction	Tensile			Compressive	Shear	Bearing			
								e/D = 1.5		e/D = 2.0	
			Ultimate (ksi)	Yield (ksi)	Elongation %	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)
2.500	T/4	L					41.6	--	112.6	106.3	147.3
	T/4	L					41.9	92.0	114.2	--	147.2
	T/4	Avg.					41.7	92.0	113.4	106.3	147.2
	T/4	LT	69.9	60.0	10.0		40.8	95.8	115.3	109.4	147.2
	T/4	LT	70.4	60.2	8.8		40.9	94.1	114.4	116.8	147.3
	T/4	Avg.	70.1	60.1	9.4		40.8	94.9	114.8	113.1	147.2
	T/2	ST	66.1	57.2	4.7	64.7					
	T/2	ST	66.2	57.2	5.3	64.5					
	T/2	Avg.	66.1	57.2	5.0	64.6					
3.000	T/4	L					39.0	92.8	112.2	111.6	143.1
	T/4	L					39.3	88.8	111.2	111.2	142.9
	T/4	Avg.					39.2	90.8	11.7	111.4	143.0
	T/4	LT	68.5	56.8	9.6		36.8	92.3	112.4	107.6	143.1
	T/4	LT	68.5	56.9	9.5		38.6	94.8	111.5	113.7	143.8
	T/4	Avg.	68.5	56.8	9.5		37.7	93.5	111.9	110.6	143.4
	T/2	ST	66.3	55.5	5.2	61.7					
	T/2	ST	--	--	--	63.3					
	T/2	Avg.	66.3	55.5	5.2	62.5					

* Reheat treated from T651 condition to designated condition.

TABLE 3

MECHANICAL PROPERTIES OF 7075-T7651

Nominal Thickness (in)	Specimen Location	Grain Direction	Tensile			Compressive	Shear	Bearing			
								e/D = 1.5		e/D = 2.0	
			Ultimate (ksi)	Yield (ksi)	Elongation %	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)	Yield (ksi)	Ultimate (ksi)
1.750	T/4	L					41.3	100.4	121.7	125.0	156.8
		L					41.8	100.4	121.8	115.1	157.2
		Avg.					42.0	100.4	121.7	120.0	157.0
		LT	75.4	65.4	10.2		42.1	98.4	122.0	122.8	157.6
		LT	74.9	65.3	9.5		41.8	101.3	121.9	122.1	157.7
		Avg.	75.1	65.3	9.8		41.9	99.8	121.9	122.4	157.6
		ST	70.6	61.8	4.8	68.0					
		ST	69.9	61.1	5.0	68.4					
		Avg.	70.2	61.4	4.9	68.2					
2.250	T/4	L					41.4	98.2	120.2	115.1	153.7
		L					41.4	95.0	120.0	114.6	153.7
		Avg.					41.4	96.6	120.1	114.8	153.7
		LT	72.9	62.5	9.1		39.9	98.1	120.7	123.0	154.2
		LT	72.9	63.2	9.0		40.7	99.1	120.2	117.6	154.8
		Avg.	72.9	62.8	9.0		40.3	98.6	120.4	120.3	154.5
		ST	69.2	61.1	4.2	67.5					
		ST	69.0	61.0	4.0	67.8					
		Avg.	69.1	61.0	4.1	67.6					

☆ U.S. GOVERNMENT PRINTING OFFICE—759-062/695